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# Bluetooth Low Energy (CCM)

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## Technical Data of 2.4GHZ Inverted F Antenna

Version: 01

### Engineering Department

**Mohamed Boudour: HW Engineer**

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### Revision History

Version	Prepared By	Date	Summary of changes
01	M.B	2022-10-05	Original Draft Version

### Reference:

Texas Instrument Application Report –SWRU120C.

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## HW Layout of CCM

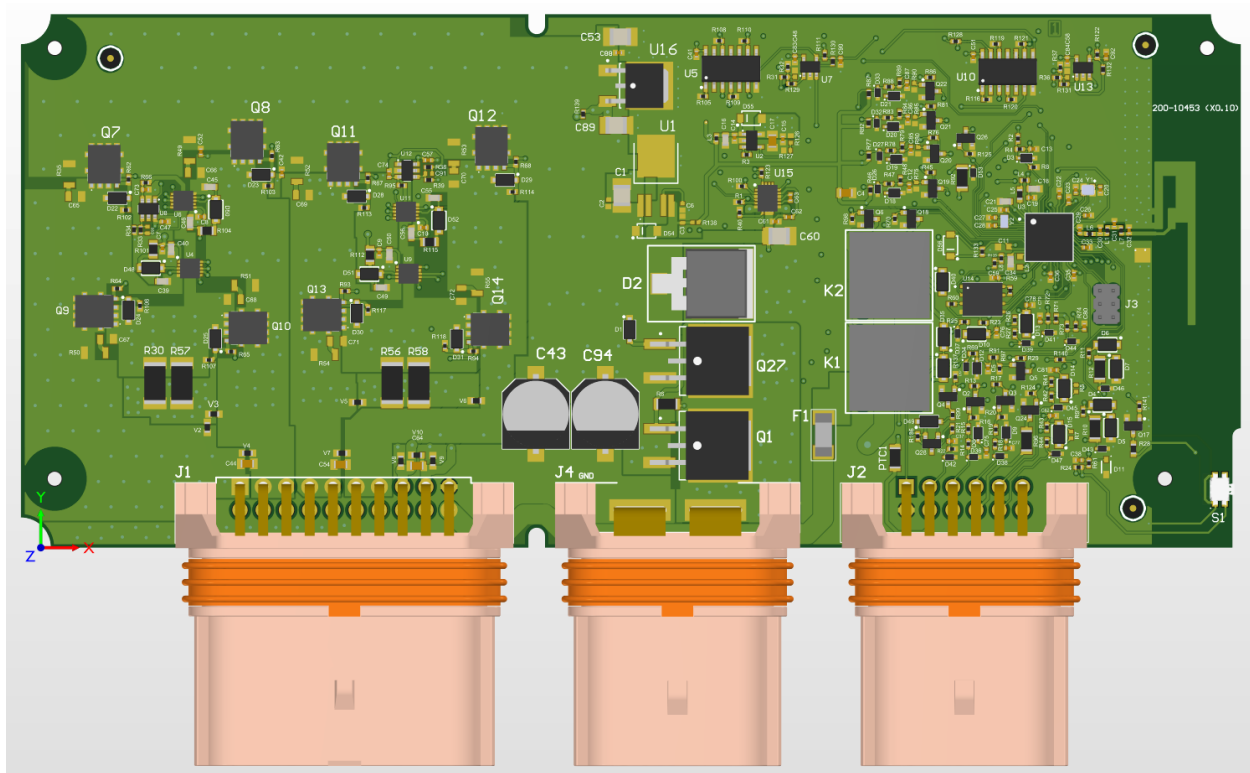


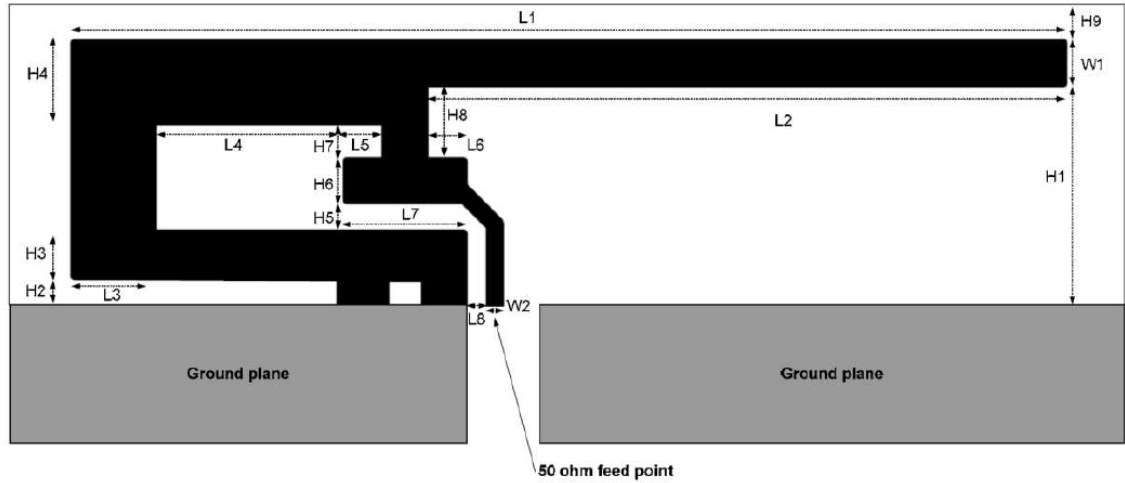
Figure 1: PCBA Board of CCM

## Description of CCM antenna

The CCM design use a 2.4GHZ PCB Inverted F antenna. The impedance of this antenna is almost matched to 50 ohm and very few external matching components are required. The maximum gain of this antenna is measured to be +3.3dBi and the overall size requirement to design it are 25.7mm x 7.5mm. Thus, this antenna is compact, low cost and high performance.

## Implementation and design specs of Inverted F Antenna

It is important to use exact dimensions to obtain optimum antenna performance. Components and ground plane should not be placed close to the end points of the antenna. Figure2 and Table1 provide dimensions of antenna design.



**Figure 1:** IF Antenna Dimensions

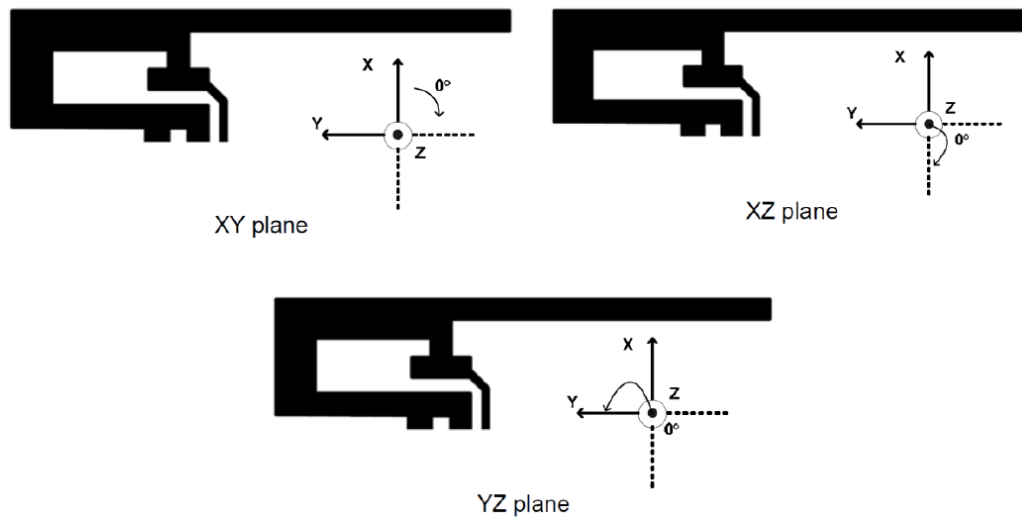
H1	5.70 mm	W2	0.46 mm
H2	0.74 mm	L1	25.58 mm
H3	1.29 mm	L2	16.40 mm
H4	2.21 mm	L3	2.18 mm
H5	0.66 mm	L4	4.80 mm
H6	1.21 mm	L5	1.00 mm
H7	0.80 mm	L6	1.00 mm
H8	1.80 mm	L7	3.20 mm
H9	0.61 mm	L8	0.45 mm
W1	1.21 mm		

**Table1:** IF Antenna Dimensions

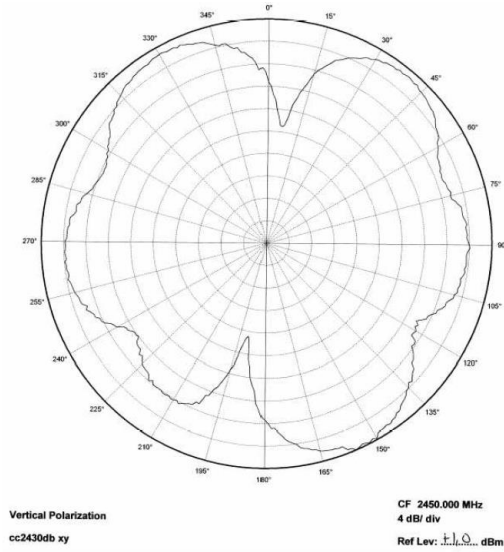
### Expected Radiation Pattern of IF Antenna

Figure3 shows how to relate all the radiation patterns to the orientation of the antenna. The radiation patterns.

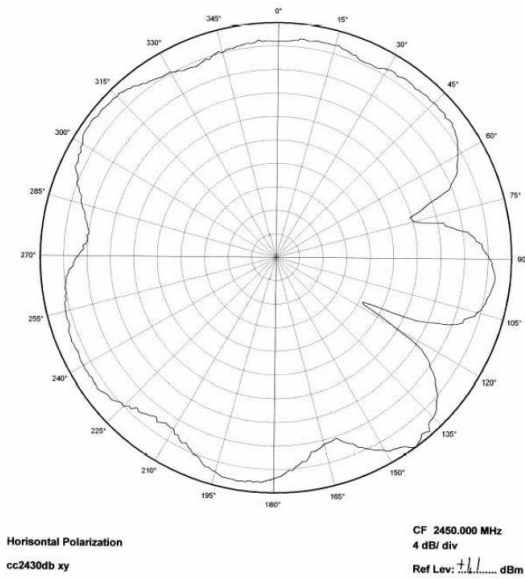
Figures: 4, 5,6,7,8 and 9 show the radiation pattern on different planes and polarizations.



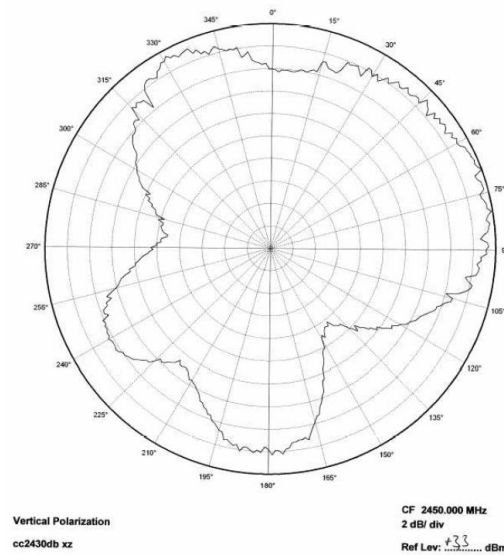
**Figure3:** Relating Antenna to Radiation Patterns



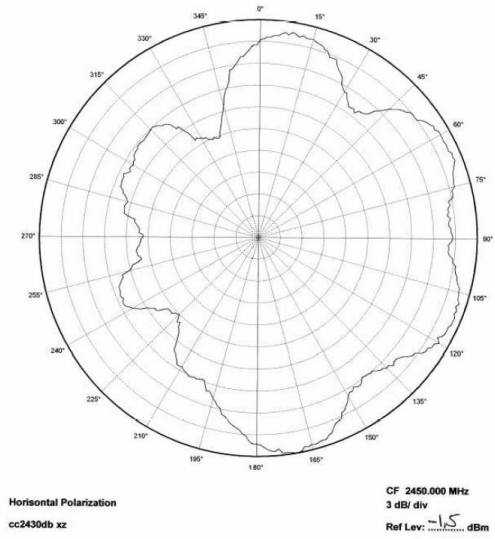
**Figure4:** XY Plane-Vertical Polarization



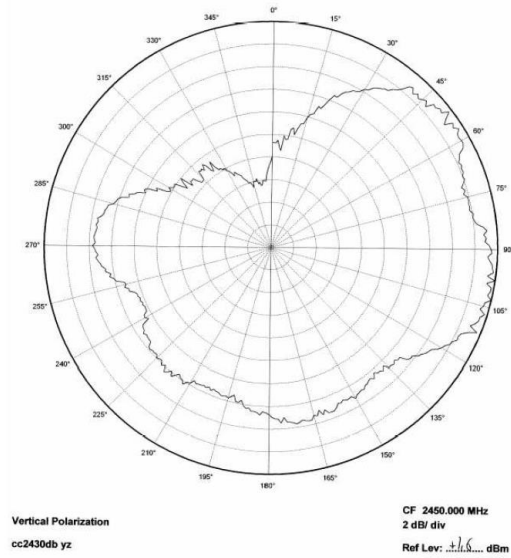
**Figure5:** XY Plane-Horizontal Polarization



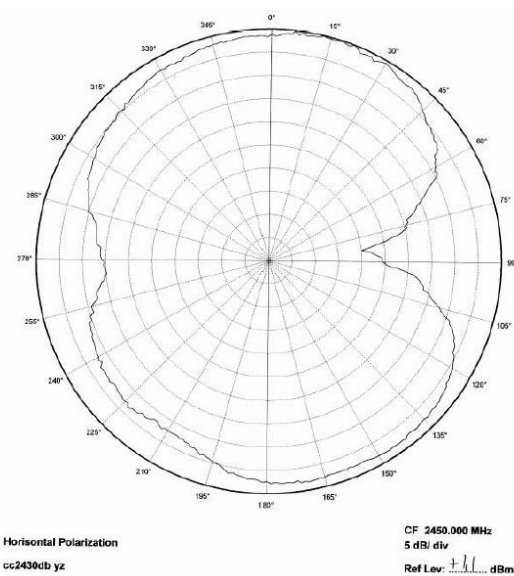
**Figure6:** XZ Plane-Vertical Polarization



**Figure7: XZ Plane-Horizontal Polarization**



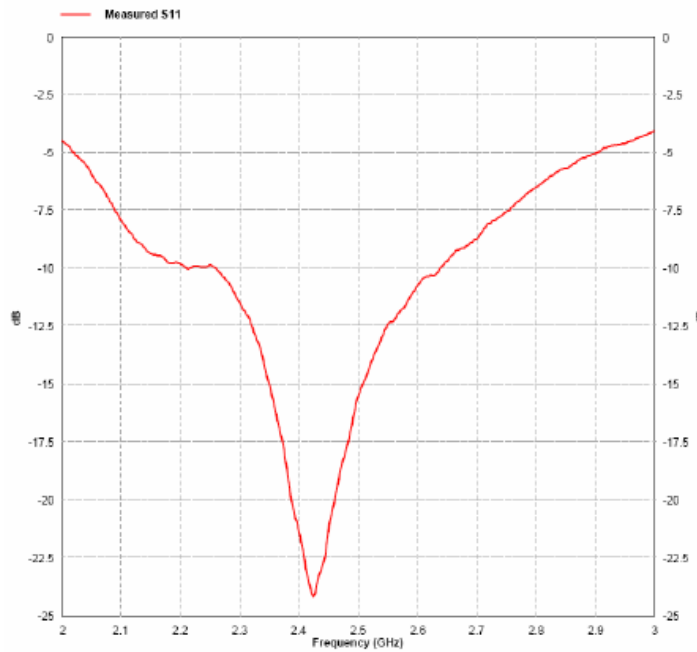
**Figure8: YZ Plane-Vertical Polarization**



**Figure9: YZ Plane-Horizontal Polarization**

### Reflection of IF Antenna

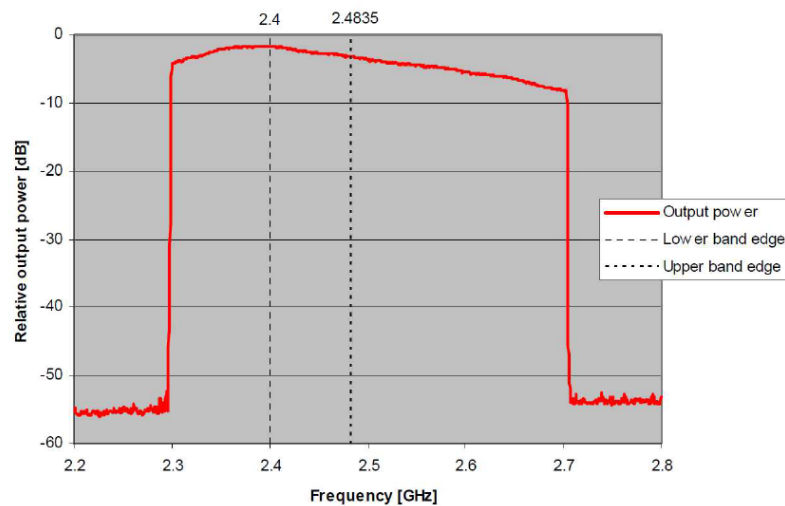
Figure10 shows that the IF Antenna ensures less than 10% reflection of the available power for a bandwidth of more than 300 MHz. A large bandwidth makes the antenna less sensitive to detuning because of plastic enclosure or other objects near to the antenna.



**Figure10:** Measured reflection at Feed Point of antenna

### Bandwidth of IF Antenna

Figure11 shows how the output power varies on the IF Antenna when the PCB is horizontally oriented and receiving antenna has horizontal polarization. This measurement was not performed in an anechoic chamber, thus the graph shows only the relative variation for the given frequency band.



**Figure11:** Bandwidth of IF Antenna

## Conclusion

This PCB IF Antenna performs well for all frequencies in the 2.4GHZ band. The antenna has an Omni directional pattern in the plane of the PCB. These properties will ensure stable performance regardless of operating frequency and positioning of the antenna. Table2 in below lists the most important characteristics of this IF Antenna.

Gain in XY plane	1.1 dBi
Gain in XZ plane	3.3 dBi
Gain in YZ plane	1.6 dBi
Reflection	< -15 dB
Antenna size	25.7 × 7.5 mm

**Table2:** Summary of IF Antenna properties

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